

The normal load factor limit on the CSeries airplanes is unique in that traditional airplanes with conventional flight control systems (mechanical linkages) are limited in the pitch axis only by the elevator surface area and deflection limit. The elevator control power is normally derived for adequate controllability and maneuverability at the most critical longitudinal pitching moment. The result is that traditional airplanes have a significant portion of the flight envelope wherein maneuverability in excess of limit structural design values is possible.

These special conditions for the CSeries airplanes supplement the applicable regulations, including § 25.143, to accommodate the unique features of the flight envelope limiting systems, and establish an equivalent level of safety to the existing regulations.

#### Discussion of Comments

Notice of proposed special conditions No. 25–13–38–SC for the Bombardier CSeries airplanes was published in the **Federal Register** on December 11, 2013 (78 FR 75285). No comments were received, and the special conditions are adopted as proposed.

#### Applicability

As discussed above, these special conditions are applicable to the Models BD–500–1A10 and BD–500–1A11 series airplanes. Should Bombardier Aerospace apply at a later date for a change to the type certificate to include another model incorporating the same novel or unusual design feature, the special conditions would apply to that model as well.

#### Conclusion

This action affects only certain novel or unusual design features on two model series of airplanes. It is not a rule of general applicability.

#### List of Subjects in 14 CFR Part 25

Aircraft, Aviation safety, Reporting and recordkeeping requirements.

The authority citation for these special conditions is as follows:

**Authority:** 49 U.S.C. 106(g), 40113, 44701, 44702, 44704.

#### The Special Conditions

Accordingly, pursuant to the authority delegated to me by the Administrator, the following special conditions are issued as part of the type certification basis for the Bombardier Aerospace Models BD–500–1A10 and BD–500–1A11 series airplanes.

#### Flight Envelope Protection: Normal Load Factor (g) Limiting

■ 1. To meet the intent of adequate maneuverability and controllability required by § 25.143(a), and in addition to the requirements of § 25.143(a) and in the absence of other limiting factors, the following special conditions based on § 25.333(b) apply:

a. The positive limiting load factor must not be less than:

(1) 2.5g for the normal state of the electronic flight control system with the high lift devices retracted.

(2) 2.0g for the normal state of the electronic flight control system with the high lift devices extended.

b. The negative limiting load factor must be equal to or more negative than:

(1) Minus 1.0g for the normal state of the electronic flight control system with the high lift devices retracted.

(2) 0.0g for the normal state of the electronic flight control system with high lift devices extended.

c. Maximum reachable positive load factor wings level may be limited by the characteristics of the electronic flight control system or flight envelope protections (other than load factor protection) provided that:

(1) The required values are readily achievable in turns, and

(2) That wings level pitch up is satisfactory.

d. Maximum achievable negative load factor may be limited by the characteristics of the electronic flight control system or flight envelope protections (other than load factor protection) provided that:

(1) Pitch down responsiveness is satisfactory, and

(2) From level flight, 0g is readily achievable or alternatively, a satisfactory trajectory change is readily achievable at operational speeds. For the FAA to consider a trajectory change as satisfactory, the applicant should propose and justify a pitch rate that provides sufficient maneuvering capability in the most critical scenarios.

e. Compliance demonstration with the above requirements may be performed without ice accretion on the airframe.

These special conditions do not impose an upper bound for the normal load factor limit, nor do they require that the limit exist. If the limit is set at a value beyond the structural design limit maneuvering load factor “n” of §§ 25.333(b) and 25.337(b) and (c), there should be a very obvious positive tactile feel built into the controller so that it serves as a deterrent to inadvertently exceeding the structural limit.

Issued in Renton, Washington, on April 22, 2014.

**Jeffrey E. Duven,**

*Manager, Transport Airplane Directorate, Aircraft Certification Service.*

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#### DEPARTMENT OF TRANSPORTATION

#### Federal Aviation Administration

#### 14 CFR Part 25

[Docket No. FAA–2013–1040; Notice No. 25–548–SC]

#### Special Conditions: Bombardier Aerospace, Models BD–500–1A10 and BD–500–1A11 Series Airplanes; Flight Envelope Protection: General Limiting Requirements

**AGENCY:** Federal Aviation Administration (FAA), DOT.

**ACTION:** Final Special Conditions.

**SUMMARY:** These special conditions are issued for the Bombardier Aerospace Models BD–500–1A10 and BD–500–1A11 series airplanes. These airplanes will have a novel or unusual design feature associated with a new control architecture and a full digital flight control system that provides flight envelope protections. The applicable airworthiness regulations do not contain adequate or appropriate safety standards for this design feature. These special conditions contain the additional safety standards that the Administrator considers necessary to establish a level of safety equivalent to that established by the existing airworthiness standards.

**DATES:** *Effective Date:* July 7, 2014.

**FOR FURTHER INFORMATION CONTACT:** Joe Jacobsen, FAA, Airplane and Flight Crew Interface Branch, ANM–111, Transport Airplane Directorate, Aircraft Certification Service, 1601 Lind Avenue SW., Renton, Washington 98057–3356; telephone 425–227–2011; facsimile 425–227–1149.

#### SUPPLEMENTARY INFORMATION:

##### Background

On December 10, 2009, Bombardier Aerospace applied for a type certificate for their new Models BD–500–1A10 and BD–500–1A11 series airplanes (hereafter collectively referred to as “CSeries”). The CSeries airplanes are swept-wing monoplanes with an aluminum alloy fuselage sized for 5-abreast seating. Passenger capacity is designated as 110 for the Model BD–500–1A10 and 125 for the Model BD–500–1A11. Maximum takeoff weight is 131,000 pounds for the

Model BD-500-1A10 and 144,000 pounds for the Model BD-500-1A11.

Bombardier has developed comprehensive flight envelope protection features integral to the CSeries electronic flight control system (EFCS) design. These flight envelope protection features include limitations on angle-of-attack, normal load factor, bank angle, pitch angle, and speed. To accomplish this flight envelope limiting, a significant change (or multiple changes) occurs in the EFCS control laws as the limit is approached or exceeded. When EFCS failure states occur, flight envelope protection features can likewise either be modified, or in some cases, eliminated. The current regulations were not written with these comprehensive flight envelope limiting systems in mind.

#### Type Certification Basis

Under the provisions of Title 14, Code of Federal Regulations (14 CFR) 21.17, Bombardier Aerospace must show that the CSeries airplanes meet the applicable provisions of part 25 as amended by Amendments 25-1 through 25-129 thereto.

If the Administrator finds that the applicable airworthiness regulations (i.e., 14 CFR part 25) do not contain adequate or appropriate safety standards for the CSeries airplanes because of a novel or unusual design feature, special conditions are prescribed under the provisions of § 21.16.

Special conditions are initially applicable to the model for which they are issued. Should the type certificate for that model be amended later to include any other model that incorporates the same or similar novel or unusual design feature, the special conditions would also apply to the other model under § 21.101.

In addition to the applicable airworthiness regulations and special conditions, the CSeries airplanes must comply with the fuel vent and exhaust emission requirements of 14 CFR part 34 and the noise certification requirements of 14 CFR part 36, and the FAA must issue a finding of regulatory adequacy under § 611 of Public Law 92-574, the "Noise Control Act of 1972."

The FAA issues special conditions, as defined in 14 CFR 11.19, in accordance with § 11.38, and they become part of the type-certification basis under § 21.17(a)(2).

#### Novel or Unusual Design Features

The CSeries airplanes will incorporate the following novel or unusual design features: New control architecture and a full digital flight control system that

provides comprehensive flight envelope protections.

#### Discussion

The applicable airworthiness regulation is 14 CFR 25.143. The purpose of § 25.143 is to verify that any operational maneuvers conducted within the operational envelope can be accomplished smoothly with average piloting skill and without exceeding any structural limits. The pilot should be able to predict the airplane response to any control input. During the course of the flight test program, the pilot determines compliance with § 25.143 primarily through qualitative methods. During flight test, the pilot should evaluate all of the following:

- The interface between each protection function;
- Transitions from one mode to another;
- Airplane response to intentional dynamic maneuvering, whenever applicable, through dedicated maneuvers;
- General controllability assessment;
- High speed characteristics; and
- High angle-of-attack.

Section 25.143, however, does not adequately ensure that the novel or unusual features of the CSeries airplanes will have a level of safety equivalent to that of existing standards. These special conditions are therefore required to accommodate the flight envelope limiting systems in the CSeries airplanes. The additional safety standards in these special conditions will ensure a level of safety equivalent to that of existing standards.

#### Discussion of Comments

Notice of proposed special conditions No. 25-13-39-SC for the Bombardier CSeries airplanes was published in the **Federal Register** on December 11, 2013 (78 FR 75287). No comments were received, and the special conditions are adopted as proposed.

#### Applicability

As discussed above, these special conditions are applicable to the Models BD-500-1A10 and BD-500-1A11 series airplanes. Should Bombardier Aerospace apply at a later date for a change to the type certificate to include another model incorporating the same novel or unusual design feature, the special conditions would apply to that model as well.

#### Conclusion

This action affects only certain novel or unusual design features on two model series of airplanes. It is not a rule of general applicability.

#### List of Subjects in 14 CFR Part 25

Aircraft, Aviation safety, Reporting and recordkeeping requirements.

The authority citation for these special conditions is as follows:

**Authority:** 49 U.S.C. 106(g), 40113, 44701, 44702, 44704.

#### The Special Conditions

Accordingly, pursuant to the authority delegated to me by the Administrator, the following special conditions are issued as part of the type certification basis for the Bombardier Aerospace Models BD-500-1A10 and BD-500-1A11 series airplanes.

##### 1. General Limiting Requirements:

a. Onset characteristics of each envelope protection feature must be smooth, appropriate to the phase of flight and type of maneuver, and not in conflict with the ability of the pilot to satisfactorily change airplane flight path, speed, or attitude as needed.

b. Limit values of protected flight parameters (and, if applicable, associated warning thresholds) must be compatible with the following:

i. Airplane structural limits;

ii. Required safe and controllable maneuvering of the airplane; and

iii. Margins to critical conditions. Unsafe flight characteristics/conditions must not result if dynamic maneuvering, airframe and system tolerances (both manufacturing and in-service), and non-steady atmospheric conditions, in any appropriate combination and phase of flight, can produce a limited flight parameter beyond the nominal design limit value.

c. The airplane must be responsive to intentional dynamic maneuvering to within a suitable range of the parameter limit. Dynamic characteristics such as damping and overshoot must also be appropriate for the flight maneuver and limit parameter in question.

d. When simultaneous envelope limiting is engaged, adverse coupling or adverse priority must not result.

2. Failure States: Electronic flight control system failures (including sensor) must not result in a condition where a parameter is limited to such a reduced value that safe and controllable maneuvering is no longer available. The crew must be alerted by suitable means if any change in envelope limiting or maneuverability is produced by single or multiple failures of the electronic flight control system not shown to be extremely improbable.

Issued in Renton, Washington, April 22, 2014.

Jeffrey E. Duven,

Manager, Transport Airplane Directorate,  
Aircraft Certification Service.

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## DEPARTMENT OF TRANSPORTATION

### Federal Aviation Administration

#### 14 CFR Part 25

[Docket No. FAA-2013-1038; Special  
Conditions No. 25-549-SC]

#### Special Conditions: Bombardier Aerospace, Models BD-500-1A10 and BD-500-1A11 Series Airplanes; Flight Envelope Protection: High-Speed Limiting

**AGENCY:** Federal Aviation  
Administration (FAA), DOT.

**ACTION:** Final Special Conditions.

**SUMMARY:** These special conditions are issued for the Bombardier Aerospace Models BD-500-1A10 and BD-500-1A11 series airplanes. These airplanes will have a novel or unusual design feature associated with an electronic flight control system that contains fly-by-wire control laws, including envelope protections, for the overspeed protection and roll-limiting function. The applicable airworthiness regulations do not contain adequate or appropriate safety standards for this design feature. These special conditions contain the additional safety standards that the Administrator considers necessary to establish a level of safety equivalent to that established by the existing airworthiness standards.

**DATES:** *Effective Date:* July 7, 2014.

**FOR FURTHER INFORMATION CONTACT:** Joe Jacobsen, FAA, Airplane and Flight Crew Interface Branch, ANM-111, Transport Airplane Directorate, Aircraft Certification Service, 1601 Lind Avenue SW., Renton, Washington 98057-3356; telephone 425-227-2011; facsimile 425-227-1149.

#### SUPPLEMENTARY INFORMATION:

##### Background

On December 10, 2009, Bombardier Aerospace applied for a type certificate for their new Models BD-500-1A10 and BD-500-1A11 series airplanes (hereafter collectively referred to as "C-Series"). The C-Series airplanes are swept-wing monoplanes with an aluminum alloy fuselage sized for 5-abreast seating. Passenger capacity is designated as 110 for the Model BD-500-1A10 and 125 for the Model BD-500-1A11. Maximum

takeoff weight is 131,000 pounds for the Model BD-500-1A10 and 144,000 pounds for the Model BD-500-1A11.

The longitudinal control law design of the Bombardier C-Series airplanes incorporates an overspeed protection system in the normal mode. This mode prevents the pilot from inadvertently or intentionally exceeding a speed approximately equivalent to the maximum speed for stability characteristics ( $V_{FC}$ ) or attaining demonstrated flight diving speed ( $V_{DF}$ ). Current Title 14, Code of Federal Regulations (14 CFR) part 25 standards did not envision a high-speed limiter that might preclude or modify flying qualities assessments in the overspeed region.

#### Type Certification Basis

Under the provisions of 14 CFR 21.17, Bombardier Aerospace must show that the C-Series airplanes meet the applicable provisions of part 25 as amended by Amendments 25-1 through 25-129 thereto.

If the Administrator finds that the applicable airworthiness regulations (i.e., 14 CFR part 25) do not contain adequate or appropriate safety standards for the C-Series airplanes because of a novel or unusual design feature, special conditions are prescribed under the provisions of § 21.16.

Special conditions are initially applicable to the model for which they are issued. Should the type certificate for that model be amended later to include any other model that incorporates the same or similar novel or unusual design feature, the special conditions would also apply to the other model under § 21.101.

In addition to the applicable airworthiness regulations and special conditions, the C-Series airplanes must comply with the fuel vent and exhaust emission requirements of 14 CFR part 34 and the noise certification requirements of 14 CFR part 36, and the FAA must issue a finding of regulatory adequacy under § 611 of Public Law 92-574, the "Noise Control Act of 1972."

The FAA issues special conditions, as defined in 14 CFR 11.19, in accordance with § 11.38, and they become part of the type-certification basis under § 21.17(a)(2).

#### Novel or Unusual Design Features

The C-Series airplanes will incorporate the following novel or unusual design features: An electronic flight control system that contains fly-by-wire control laws, including envelope protections, for the overspeed protection and roll-limiting function. Current part 25 requirements do not contain appropriate

standards for high-speed protection systems.

#### Discussion

The overspeed protection functionality includes multifunction spoilers (MFS) that will automatically deploy as speed brakes once the airspeed exceeds a small tolerance above maximum operating limit speed ( $V_{mo}/M_{mo}$ ); the MFS will retract automatically when speed is subsequently reduced. Special conditions are necessary in addition to the requirements of § 25.143 for the operation of the high-speed protection. The general intent is that the overspeed protection does not impede normal maneuvering and speed control, and that the overspeed protection does not restrict or prevent emergency maneuvering.

These special conditions contain the additional safety standards that the Administrator considers necessary to establish a level of safety equivalent to that established by the existing airworthiness standards.

#### Discussion of Comments

Notice of proposed special conditions No. 25-13-38-SC for the Bombardier C-Series airplanes was published in the **Federal Register** on December 11, 2013 (78 FR 75284). We received one comment in favor of the proposed special conditions as written.

#### Applicability

As discussed above, these special conditions are applicable to the Models BD-500-1A10 and BD-500-1A11 series airplanes. Should Bombardier Aerospace apply at a later date for a change to the type certificate to include another model incorporating the same novel or unusual design feature, the special conditions would apply to that model as well.

#### Conclusion

This action affects only certain novel or unusual design features on two model series of airplanes. It is not a rule of general applicability.

#### List of Subjects in 14 CFR Part 25

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#### The Special Conditions

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